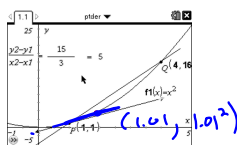


2.4b Instantaneous Rate of Change

Estimate the instantaneous velocity at $t=1$

$$\frac{1.01^2 - 1}{1.01 - 1} \approx 2.01$$

$$\frac{1.001^2 - 1}{1.001 - 1} = 2.001$$



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Find the exact instantaneous velocity at $t=1$

$$\lim_{h \rightarrow 0} \frac{f(1+h) - f(1)}{h} = \lim_{h \rightarrow 0} \frac{(1+h)^2 - 1}{h}$$

$$\lim_{h \rightarrow 0} \frac{1 + 2h + h^2 - 1}{h} = \lim_{h \rightarrow 0} \frac{h(2+h)}{h} = 2$$

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Example 3 Find the equation of the tangent to the parabola $y=x^2$ at $x=2$

$$y = 4(x-2) + 4$$

$$\lim_{h \rightarrow 0} \frac{(2+h)^2 - 4}{2+h-2}$$

$$\lim_{h \rightarrow 0} \frac{4 + 4h + h^2 - 4}{h}$$

$$\lim_{h \rightarrow 0} \frac{4h + h^2}{h} = \lim_{h \rightarrow 0} \frac{h(4+h)}{h} = \lim_{h \rightarrow 0} (4+h) = 4$$

slope of tan

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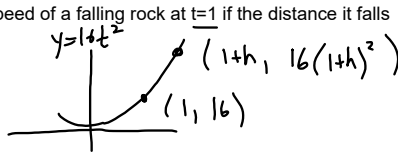
Example 5 Find an equation for the normal to the curve $y=4-x^2$ at $x=1$

Example 5 Find an equation for the normal to the curve $y=4-x^2$ at $x=1$

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Example 6 Find the speed of a falling rock at $t=1$ if the distance it falls is $y=16t^2$

$32 \frac{\text{ft}}{\text{sec}}$



$$\lim_{h \rightarrow 0} \frac{16(1+h)^2 - 16}{1+h - 1} = \lim_{h \rightarrow 0} \frac{16(1+2h+h^2) - 16}{h}$$

$$\lim_{h \rightarrow 0} \frac{\cancel{16} + 32h + 16h^2 - \cancel{16}}{h} = \lim_{h \rightarrow 0} \frac{\cancel{h}(32 + 16h)}{\cancel{h}} = 32$$

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